

HOWLAND (E. P.)

PAPER

READ BY

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DR. E. P. HOWLAND

OF

WASHINGTON, D. C.,

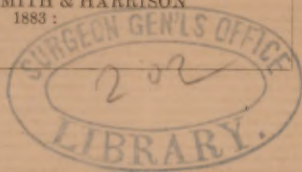
BEFORE THE

American Association for the Advancement of Science.

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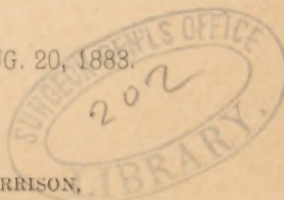
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(Paper read by Dr. E. P. Howland, of Washington, D. C., before the American Association for the Advancement of Science, at Minneapolis, August 20th, 1883.)

THE APPLICATION

**Of Nitrous Oxide and Air, or Nitrous Oxide
and Oxygen, Under Pressure to Produce An-
æsthesia in Persons for Dental and
Surgical Operations.**

From my own experiments and the practical operations made in Paris, I believe that the administration of nitrous oxide and air or nitrous oxide and oxygen, in condensed air chambers, will yet supersede the use of ether and chloroform in prolonged dental and surgical operations, as nitrous oxide has already superseded them in ordinary dental operations. The reason why nitrous oxide cannot be used for prolonged operations as ordinarily administered, is that the blood does not obtain any oxygen from it, the nitrous oxide being exhaled from the lungs undecomposed, and if breathed without air or

oxygen will produce asphyxia. I have administered nitrous oxide for dental and surgical operations to over 30,000 persons, and have found that when pure nitrous oxide is administered without any admixture of air, the average time of producing anæsthesia is 50 seconds, and the average time from the first commencement of breathing the gas till return of consciousness is two minutes. I have administered pure nitrous oxide in over 300 surgical operations in the city of Washington; the longest time a patient being unconscious was 35 minutes during a capital operation. The operation was performed by Dr. Bliss and Dr. Stuart. The skill and experience required in administering pure nitrous oxide for these operations can be acquired but by few persons, as when the patient has become anæsthetized, air has to be breathed to prevent asphyxia. and before consciousness returns, again breathing nitrous oxide, the interval varying from one-fourth to one-half minute. Pure nitrous oxide will never be made practical for prolonged operations.

In my experiments on animals in having them breathe pure nitrous oxide, death generally occurs in about $2\frac{1}{2}$ minutes, the animal sometimes living four minutes. If air or oxygen is mixed with nitrous oxide in sufficient quantity to pre-

vent asphyxia, it will not produce anæsthesia. But it can be mixed with equal quantities of air and breathed from a gas-bag in a condensed air chamber at 15 lbs. pressure per square inch, or mixed with oxygen in the proportion of 85 parts nitrous oxide to 15 parts oxygen, in a chamber where the surrounding air is compressed to 5 lbs. per square inch, and the mixture can be breathed an indefinite length of time, without danger or injury, producing perfect anæsthesia and perfectly oxygenating the blood. The compressed air in the chamber being merely used to compress the mixture in the gas-bag into a smaller space, so that the patient can breathe sufficient nitrous oxide to produce anæsthesia and sufficient air or oxygen to oxygenate the blood.

The application of nitrous oxide and air or oxygen as an anæsthetic agent for prolonged operations has but a very recent history.

On the second day of February, 1878, Paul Bert announced to the Biological Society of Paris his discovery as the result of theoretical deductions of a process by which the anæsthetic properties of nitrous oxide could be used without danger of asphyxia. No experience had yet been obtained. When Paul Bert passed from theory to practice, and experimented upon ani-

mals, he saw all his experiments crowned with the greatest success. The results that he had announced in advance were realized beyond his hopes. The animals were plunged into a profound insensibility which could be indefinitely prolonged, and during which none of their vital functions were disturbed. The method was excellent in every respect. Encouraged by this result Paul Bert resolved to apply to man the same method, and to perform by means of it, the longest and most painful operations. In a note to the Academy of Sciences of Paris, under date of Nov. 11th, 1878, he appeals to surgeons. He says: "I am now authorized, by my experience with animals, to commend urgently to surgeons, the use of nitrous oxide and oxygen under pressure, with the view of producing insensibility of long duration. I can assure them that by measuring, as I have indicated, the barometric pressure and the centesimal composition of the mixture so as to have for the nitrous oxide the tension of the atmosphere, and for the oxygen at least the normal tension of the surrounding area, they will obtain an insensibility and a muscular relaxation as complete as they may desire, followed by an immediate return to sensibility and perfect comfort. There is even a singular ease in applying this medical agent, for should there

be slight inequalities in its effects upon different individuals, as must necessarily be the case on account of special susceptibilities, the barometric pressure need only be slightly increased or diminished as is very easily done by means of regulating cocks. I know there are some difficulties to be overcome in the construction of the chambers in the application of this new anæsthetic, but for me as a physiologist, it ought to be enough to have pointed out the agent, shown the immense advantage of its use and insisted among other things on its harmlessness, so marvelous and so easily applicable."

Two Parisian hospital surgeons, Dr. Léon Labbié and Dr. Péan, responded to this appeal. The first operation performed, Feb. 15, 1879, by Dr. L. Labbié, was already sufficient to demonstrate the excellence of the method and the precious advantages to be derived from it. Subsequent operations performed partly by Dr. Labbié and partly by Dr. Péan, have given more éclat to that demonstration.

These expectations of Paul Bert were then completely realized. Nitrous oxide and oxygen had definitely entered the domain of grand surgery, and the superiority of this anæsthetic agent over ether and chloroform had been forever demonstrated. His success was complete,

and in a note addressed to the Academy of Sciences of Paris, Paul Bert mentioned the happy results of the first operations performed by the able surgeons just named. The surgeons, who doubtless had at first been frightened by the necessity of staying in compressed air, or by the sight of the metallic chamber in which they should perform their operations, were then disquieted by this method, to which they had previously manifested a strange indifference. Dr. Périér surgeon of the hospital of St. Antoine, began May 7th, 1880, to operate with nitrous oxide and oxygen, and on May 20th, Dr. Ledentu, surgeon of the hospital of St. Louis, made his first operation with Paul Bert's anæsthetic process. All these operations succeeded perfectly. Operations were also performed by Dr. Rottenstein, Dr. Regnard, Dr. Blanchard, Dr. Brochin, Dr. Fontaine and others. The surgeons of Paris have now performed several hundred operations, which have all been crowned with the most brilliant success. The method is in a good way and will, no doubt, in a short time supplant ether and chloroform, at least, in hospital and city practice, and I think that the greater facilities in administering this agent, regulating the pressure and purifying the air from infectious germs in the air chamber that I

have devised, will greatly facilitate its introduction. I condense a few recorded operations made in Paris and published by Dr. Raphael Blanchard, of Paris, from whose works on anaesthesia I have largely quoted.

Removal of a tumor of the breast under the direction of Paul Bert, the operation performed by Dr. Péan at the Hospital St. Louis. The disease was carcinoma of the mammary gland. The operation was performed under a pressure of seventeen to nineteen centimetres mercury (about four pounds pressure per square inch) eighty-five parts nitrous oxide, and fifteen parts oxygen, administered. The patient was 1 minute and 15 seconds becoming anaesthetized, when the operation was commenced and the patient gave no sign of sensibility. Time of operation and dressing was 14 minutes. At the termination of the operation she descended alone from the operating table. No unpleasant effect from anaesthesia.

Amputation of leg. A man of about 50 years. Three years before, the patient had been operated upon by Dr. Péan for a tumor on the internal ankle of the right leg. The tumor having reappeared, necessitated a new operation. Anaesthesia complete after 65 seconds of inhalation of nitrous oxide and oxygen. A slight

agitation at first. Wishing to save as much of the patient's limb as possible, Dr. Péan first tried to remove the tumor with a thermo cautery; but after he had made a crucial incision and turned back the flaps, it was evident that the tumor extended upward behind the tibia, and he determined to amputate the leg at the smallest part by the circular method. The two times of the operation lasted an hour and ten minutes. Dr. Péan had four assistants, and ten other persons were in the chamber. Maximum pressure of air in the chamber, 30 centimetres of mercury. (About six pounds pressure per square inch.)

Margaret Munier, aged 61. Dr. Péan, operator. Cancer of the right breast. Insensibility in one hundred seconds. Operation lasts eight minutes. At its termination inhalation is suspended. Sensibility returns in fifteen seconds. Nitrous oxide and oxygen is again given to sew up and bind the wound. This lasts six minutes. Inhalation is then stopped. The patient awakes in fifty seconds and speaks at the end of one hundred and ten seconds.

Resection of the first and third metatarsal bones. Operator, Dr. Labbié. Operation lasts 32 minutes and 30 seconds. When he awoke in two minutes in possession of all his faculties

and recognized and thanked all the persons about him.

Operation, cancer of the breast, patient Josephine Billat, 54 years of age. Operator, Dr. Labbier. Pressure in air chamber 25 centimetres, mercury, (about five pounds to the square inch). Became anesthetized in two minutes. Operation a long and tedious one in removing all the affected parts, lasting sixty-two minutes. Sleep very calm during the whole operation and awoke in two minutes after without unpleasant feelings.

As may be seen the operations performed in this manner are already numerous and all have given the most satisfactory results.

The general conclusions to which we are led by the foregoing exposition may be formulated as follows:

(1st.) Nitrous oxide administered under pressure and mixed with oxygen, produces within several seconds a profound insensibility.

(2nd.) Under these conditions life may be indefinitely sustained without the least danger of asphyxia.

(3rd.) In augmenting or diminishing the pressure the progress of anaesthesia may be regulated at will, and with mathematical precision. Therefore there is no danger of any of the acci-

dents incurred through the use of ether or chloroform.

(4th.) When inhalation of nitrous oxide and oxygen is stopped, the patient recovers consciousness in a few seconds and feels no consequent discomfort.

(5th.) Nitrous oxide is merely dissolved in the plasma of the blood, and escapes when inhalation ceases.

(6th.) Its use causes no trouble to nutrition and no change in the chemical composition of the organs or cessation of their functions.

(7th.) The action of compressed air upon the operator and his assistants need not be feared. Compressed air is very efficacious in the treatment of catarrh of the mucous membrane of the nose, the eustachian tube, and the respiratory channels generally.

(8th.) By reason of these facts nitrous oxide and oxygen is proven to be superior to ether or chloroform, whether we consider its profound anæsthetic effect, or its freedom from injurious results.

(9th.) If the pressure of the air chamber is rightly and properly regulated, it is absolutely impossible for the patient to run any risk by anæsthesia, alone.

(10th.) In all that concerns the application

of nitrous oxide and oxygen to surgery, the scientific phase may be said to be exhausted and this anæsthetic can and should be henceforth used for operations of indefinite duration instead of ether and chloroform.

After the reading of the paper an animal was placed in an experimental air chamber, and nitrous oxide and oxygen administered. The animal remained anæsthetized for several minutes, and when removed recovered in 20 seconds. The animal was again placed in the chamber and pure nitrous oxide administered, without pressure, when the animal died within 2 minutes. The animal was then decapitated, the dark blood proving that it died from asphyxia, the blood not being oxygenated, and not from the effects of the nitrous oxide, as the animal had been breathing for several minutes under pressure the same amount per minute of nitrous oxide, with the oxygen, as it did in the last experiment without the oxygen.

